Amendments to the Claims

This listing of claims will replace all prior versions and listings of claims in the application:

Listing of Claims:

Claim 1 (withdrawn): A method for measuring at least one metal analyte in a halosilane source, comprising:

(a) collecting a first sample from a halosilane source, wherein the first sample comprises at least one halosilane having a formula $Si_uCl_vF_wBr_xI_yN_z$, wherein u is 1or 2; (v+w+x+y) is an integer between 1 and 4+2(u-1), inclusive; each of v, w, x, and y is an integer between 0 and 4+2(u-1), inclusive; z is an integer between 0 and 2u+1, inclusive; (v+w+x+y+z) is equal to 4+2(u-1); and each N is independently selected from the group consisting of hydrogen, methyl, methoxy, ethyl, ethoxy, propyl, propoxy, isopropyl, isopropoxy, n-butyl, butoxy, vinyl, and phenyl,

(b) contacting the first sample with an aqueous hydrofluoric acid solution, thereby producing a liquid reaction mixture,

wherein at least one chemical reaction occurs as a result of the contacting step, wherein the chemical reaction comprises the halosilane reacting with the aqueous hydrofluoric acid solution;

(c) evaporating liquid from the liquid reaction mixture, thereby producing a near-dry residue;

(d) mixing the near-dry residue with a take-up liquid, thereby producing a second sample; and

(e) analyzing the second sample for the presence of a detectable amount of at least one metal analyte.

Claim 2 (withdrawn): The method of claim 1, wherein the first sample is a liquid.

Claim 3 (withdrawn): The method of claim 1, wherein the first sample is a gas.

Claim 4 (withdrawn): The method of claim 1, wherein the first sample further comprises nitrogen gas or hydrogen gas.

Claim 5 (withdrawn): The method of claim 1, wherein the halosilane is a chlorosilane.

Claim 6 (withdrawn): The method of claim 1, wherein each of w, x, and y is 0.

Claim 7 (withdrawn): The method of claim 1, wherein the halosilane is selected from the group consisting of monochlorosilane, dichlorosilane, trichlorosilane, tetrachlorosilane, methyltrichlorosilane, methyldichlorosilane, methylmonochlorosilane, dimethyldichlorosilane, dimethylchlorosilane, trimethylchlorosilane, hexachlorodisilane, triethoxyfluorosilane, phenyldiethoxychlorosilane, tetraethoxysilane, tetrafluorosilane, tetrabromosilane, and tetraiodosilane.

Claim 8 (withdrawn): The method of claim 1, wherein the halosilane is selected from the group consisting of trichlorosilane, dichlorosilane, tetrachlorosilane, and tetrafluorosilane.

Claim 9 (withdrawn): The method of claim 1, wherein the halosilane is trichlorosilane.

Claim 10 (withdrawn): The method of claim 1, wherein the first sample comprises trichlorosilane and hydrogen.

Claim 11 (withdrawn): The method of claim 1, wherein the first sample comprises trichlorosilane and nitrogen.

Claim 12 (withdrawn): The method of claim 1, wherein the aqueous hydrofluoric acid solution comprises between about 49 wt% and 5 wt% hydrofluoric acid.

Claim 13 (withdrawn): The method of claim 1, wherein the aqueous hydrofluoric acid solution comprises between about 35 wt% hydrofluoric acid and 15 wt% hydrofluoric acid.

Claim 14 (withdrawn): The method of claim 1, wherein the aqueous hydrofluoric acid solution comprises about 25 wt% hydrofluoric acid.

Claim 15 (withdrawn): The method of claim 1, wherein the take-up liquid comprises nitric acid and hydrogen peroxide.

Claim 16 (withdrawn): The method of claim 1, wherein the first sample is contacted with the aqueous hydrofluoric acid solution in the presence of a shield gas.

Claim 17 (withdrawn): The method of claim 16, wherein the shield gas is nitrogen, argon, or helium.

Claim 18 (withdrawn): The method of claim 16, wherein the shield gas is nitrogen.

Claim 19 (withdrawn): The method of claim 1, wherein the metal analyte is selected from the group consisting of iron, molybdenum, chromium, zinc, magnesium, tin, titanium, nickel, copper, aluminum, boron, phosphorous, calcium, sodium, manganese, vanadium, potassium, lithium, beryllium, gallium, germanium,

arsenic, strontium, zirconium, niobium, cobalt, silver, cadmium, indium, antimony, barium, tantalum, thallium, lead, and bismuth.

Claim 20 (withdrawn): The method of claim 1, wherein the metal analyte is selected from the group consisting of boron, phosphorous, arsenic, antimony, germanium, iron, chromium, nickel, manganese, and molybdenum.

Claim 21 (withdrawn): The method of claim 1, wherein the metal analyte is selected from the group consisting of boron, phosphorus, and arsenic.

Claim 22 (withdrawn): The method of claim 1, wherein the analyzing step is performed using graphite furnace atomic absorption (GFAA) or inductively coupled plasma-mass spectrometry (ICP-MS).

Claim 23 (withdrawn): The method of claim 1, wherein the analyzing step is performed using dynamic reaction cell inductively coupled plasma-mass spectrometry (DRC ICP-MS).

Claim 24 (withdrawn): The method of claim 1, wherein the analyzing step is performed using high resolution inductively coupled plasma-mass spectrometry.

Claim 25 (withdrawn): The method of claim 1, wherein the volume of the hydrofluoric acid solution is between about 400 and 500 ml, and the first sample is contacted with the aqueous hydrofluoric solution at a flow rate of between about 0.5 g/min and 1 g/min.

Claim 26 (withdrawn): A method for measuring at least one metal analyte in a chlorosilane source, comprising:

(a) collecting a first sample from a chlorosilane source, wherein the first sample comprises at least one chlorosilane,

(b) contacting the first sample with an aqueous hydrofluoric acid solution, thereby producing a liquid reaction mixture,

wherein at least one chemical reaction occurs as a result of the contacting step, wherein the chemical reaction comprises the chlorosilane reacting with the aqueous hydrofluoric acid solution;

(c) evaporating liquid from the liquid reaction mixture, thereby producing a near-dry residue;

(d) mixing the near-dry residue with a take-up liquid, thereby producing a second sample; and

(e) analyzing the second sample for the presence of a detectable amount of at least one metal analyte.

Claim 27 (withdrawn): The method of claim 26, wherein the chlorosilane has a formula $Si_uCl_vN_z$, wherein u is 1 or 2; v is an integer between 1 and 4+2(u-1), inclusive; z is an integer between 0 and 2u+1, inclusive; (v+z) is equal to 4+2(u-1); and each N is independently selected from the group consisting of hydrogen, iodo, bromo, fluoro, methyl, methoxy, ethyl, ethoxy, propyl, propoxy, isopropyl, isopropoxy, n-butyl, butoxy, vinyl, and phenyl.

Claim 28 (withdrawn): The method of claim 27, wherein each N is independently selected from the group consisting of hydrogen, methyl, methoxy, ethyl, ethoxy, propyl, propoxy, isopropyl, isopropoxy, n-butyl, butoxy, vinyl, and phenyl.

Claim 29 (withdrawn): The method of claim 26, wherein the chlorosilane is selected from the group consisting of trichlorosilane, dichlorosilane, and tetrachlorosilane.

Claim 30 (withdrawn): The method of claim 26, wherein the aqueous hydrofluoric acid solution comprises about 25 wt% hydrofluoric acid.

Claim 31 (withdrawn): The method of claim 26, wherein the take-up liquid comprises nitric acid and hydrogen peroxide.

Claim 32 (withdrawn): The method of claim 26, wherein the first sample is contacted with the aqueous hydrofluoric acid solution in the presence of a shield gas.

Claim 33 (withdrawn): The method of claim 26, wherein metal analyte is selected from the group consisting of boron, phosphorous, arsenic, antimony, germanium, iron, chromium, nickel, manganese, and molybdenum.

Claim 34 (withdrawn): The method of claim 26, wherein the analyzing step is performed using graphite furnace atomic absorption (GFAA) or inductively coupled plasma-mass spectrometry (ICP-MS).

Claim 35 (currently amended): A system for measuring at least one metal analyte from a halosilane source, comprising:

(a) a halosilane source comprising at least one halosilane having a formula $Si_uCl_vF_wBr_xI_yN_z$, wherein u is 1or 2; (v+w+x+y) is an integer between 1 and 4+2(u-1), inclusive; each of v, w, x, and y is an integer between 0 and 4+2(u-1), inclusive; z is an integer between 0 and 2u+1, inclusive; (v+w+x+y+z) is equal to 4+2(u-1); and each N is independently selected from the group consisting of hydrogen, methyl, methoxy, ethyl, ethoxy, propyl, propoxy, isopropyl, isopropoxy, n-butyl, butoxy, vinyl, and phenyl,

(b) at least one reaction system coupled to said halosilane source, wherein

a first sample comprising the halosilane is collected from the halosilane source, wherein the first sample and with an aqueous hydrofluoric acid solution are contacted in the reaction system to produce a liquid reaction mixture, and the reaction system comprises:

a sample introduction line to carry the first sample,

a shield gas supply line,

a shield gas functional line,

wherein the shield gas supply line and the shield gas functional line are to carry a shield gas,

wherein the shield gas functional line has a longitudinal axis that is parallel to the longitudinal axis of the sample introduction line, and the sample shield gas functional line jackets at least a portion of the sample introduction line,

wherein the jacketed portion of the sample introduction line comprises an open end and a continuing end, and

wherein the shield gas functional line comprises a first end that is sealed to the continuing end of the portion of the sample introduction line and an open end,

a connector that connects the shield gas supply line and the shield gas functional line,

wherein the open end of the jacketed portion of the sample introduction line and the open end of the shield gas functional end are on the same side relative to the connector, and

an impinger comprising a reaction vessel and the aqueous hydrofluoric acid solution therein,

wherein the open end of the shield gas functional line and the open end of the jacketed portion of the sample introduction line are positioned below the surface of the aqueous hydrofluoric acid solution, and

wherein the open end of the shield gas functional line and the open end of the sample introduction line are positioned relative to one another such that when the shield gas and the first sample are carried through the reaction system, the shield gas is capable of shielding the first sample when the first sample is contacted with the aqueous hydrofluoric acid solution, thereby producing the liquid reaction mixture,

(c) an evaporator, wherein the evaporator is used to evaporate liquid from the liquid reaction mixture to produce a near-dry residue, wherein the near-dry residue is mixed with a take-up liquid to produce a second sample, and

(d) a metal analyte detector, wherein the metal analyte detector is used to analyze the second sample for the presence of a detectable amount of at least one metal analyte.

Claim 36 (previously presented): The system of claim 35, wherein the halosilane source is selected from the group consisting of a halosilane canister, a halosilane bulk storage tank, halosilane supply line, and a deposition chamber.

Claim 37 (previously presented): The system of claim 35, wherein the halosilane source is a chlorosilane source comprising at least one chlorosilane.

Claim 38 (cancelled)

Claim 39 (currently amended): The system of claim [[38]] 35, wherein at least one of the sample introduction line, the shield gas supply line, the shield gas functional line, the connector, or the reaction vessel comprises polytetrafluoroethylene (PTFE).

Claim 40 (currently amended): The system of claim [[38]] 35, wherein at least one of the sample introduction line, the shield gas supply line, the shield gas functional line, the connector, or the reaction vessel comprises perfluoroalkoxy (PFA).

Claim 41 (currently amended): The system of claim [[38]] 35, wherein the connector is a tee connector.

Claim 42 (currently amended): The system of claim [[38]] 35, wherein the aqueous hydrofluoric acid solution comprises between about 49 wt% and 5 wt% hydrofluoric acid.

Claim 43 (currently amended): The system of claim [[38]] 35, wherein contacting the first sample with the aqueous hydrofluoric acid solution in the impinger further produces an exhaust gas, and wherein the reaction system further comprises an abatement line and an abatement unit, wherein the abatement line is capable of carrying the exhaust gas from the impinger to the abatement unit, and the abatement unit comprises an abatement vessel and an aqueous caustic solution.

Claim 44 (previously presented): The system of claim 35, wherein the detector uses graphite furnace atomic absorption (GFAA) or inductively coupled plasma-mass spectrometry (ICP-MS).

Claim 45 (previously presented): The system of claim 35, wherein the detector is capable of detecting at least one metal analyte selected from the group consisting of

boron, phosphorous, arsenic, antimony, germanium, iron, chromium, nickel, manganese, and molybdenum.

Claim 46 (previously presented): The system of claim 35, wherein the detector is capable of detecting less than about one ppbw of at least one metal analyte.

Claim 47 (previously presented): The system of claim 35, wherein each of w, x, and y is 0.

Claim 48 (withdrawn): A system for measuring at least one metal analyte from a chlorosilane source, comprising:

a chlorosilane source comprising at least one chlorosilane,

at least one reaction system coupled to said chlorosilane source, wherein a first sample comprising the chlorosilane is collected from the chlorosilane source, wherein the first sample and with an aqueous hydrofluoric acid solution are contacted in the reaction system to produce a liquid reaction mixture,

an evaporator, wherein the evaporator is used to evaporate liquid from the liquid reaction mixture to produce a near-dry residue, wherein the near-dry residue is mixed with a take-up liquid to produce a second sample, and

a metal analyte detector, wherein the metal analyte detector is used to analyze the second sample for the presence of a detectable amount of at least one metal analyte.

Claim 49 (withdrawn): The system of claim 48, wherein the chlorosilane has a formula $Si_uCl_vN_z$, wherein u is 1 or 2; v is an integer between 1 and 4+2(u-1), inclusive; z is an integer between 0 and 2u+1, inclusive; (v+z) is equal to 4+2(u-1); and each N is independently selected from the group consisting of hydrogen, iodo,

bromo, fluoro, methyl, methoxy, ethyl, ethoxy, propyl, propoxy, isopropyl, isopropoxy, n-butyl, butoxy, vinyl, and phenyl.

Claim 50 (withdrawn): The system of claim 49, wherein each N is independently selected from the group consisting of hydrogen, methyl, methoxy, ethyl, ethoxy, propyl, propoxy, isopropyl, isopropoxy, n-butyl, butoxy, vinyl, and phenyl.

Claim 51 (withdrawn): A system for measuring at least one metal analyte in a halosilane source, comprising:

(a) a means for collecting a first sample from a halosilane source, wherein the first sample comprises at least one halosilane having a formula $Si_uCl_vF_wBr_xI_yN_z$, wherein u is 1or 2; (v+w+x+y) is between 1 and 4+2(u-1), inclusive; each of v, w, x, and y is between 0 and 4+2(u-1), inclusive; z is between 0 and 2u+1; (v+w+x+y+z) is equal to 4+2(u-1); and each N is independently selected from the group consisting of hydrogen, methyl, methoxy, ethyl, ethoxy, propyl, propoxy, isopropyl, isopropoxy, n-butyl, butoxy, vinyl, and phenyl,

(b) a means for contacting the first sample with an aqueous hydrofluoric acid solution, thereby producing a liquid reaction mixture,

wherein at least one chemical reaction occurs as a result of the contacting step, wherein the chemical reaction comprises the chlorosilane reacting with the aqueous hydrofluoric acid solution;

(c) a means for evaporating liquid from the liquid reaction mixture, thereby producing a near-dry residue;

(d) a means for mixing the near-dry residue with a take-up liquid, thereby producing a second sample; and

(e) a means for analyzing the second sample for the presence of a detectable amount of at least one metal analyte.

Claim 52 (withdrawn): The system of claim 51, wherein each of w, x, and y is 0.

Claim 53 (currently amended): A system for sampling for at least one metal analyte in a halosilane supply, comprising:

(a) a halosilane supply line to transport at least one halosilane having a formula $Si_uCl_vF_wBr_xI_yN_z$, wherein u is 1or 2; (v+w+x+y) is between 1 and 4+2(u-1), inclusive; each of v, w, x, and y is between 0 and 4+2(u-1), inclusive; z is between 0 and 2u+1; (v+w+x+y+z) is equal to 4+2(u-1); and each N is independently selected from the group consisting of hydrogen, methyl, methoxy, ethyl, ethoxy, propyl, propoxy, isopropyl, isopropoxy, n-butyl, butoxy, vinyl, and phenyl,

(b) a sampling unit coupled with said halosilane supply line, wherein

(i) said sampling unit, comprises:

a sample introduction line to carry the first sample;

a shield gas supply line;

a shield gas functional line,

wherein the shield gas supply line and the shield gas functional line are to carry a shield gas,

wherein the shield gas functional line has a longitudinal axis that is parallel to the longitudinal axis of the sample introduction line, and the sample shield gas functional line jackets at least a portion of the sample introduction line,

wherein the jacketed portion of the sample introduction line comprises an open end and a continuing end, and

wherein the shield gas functional line comprises a first end that is sealed to the continuing end of the

portion of the sample introduction line and an open end;

a connector that connects the shield gas supply line and the shield gas functional line,

wherein the open end of the jacketed portion of the sample introduction line and the open end of the shield gas functional end are on the same side relative to the connector;

an impinger comprising a reaction vessel and the aqueous hydrofluoric acid solution therein,

wherein the open end of the shield gas functional line and the open end of the jacketed portion of the sample introduction line are positioned below the surface of the aqueous hydrofluoric acid solution, and

wherein the open end of the shield gas functional line and the open end of the sample introduction line are positioned relative to one another such that when the shield gas and the first sample are carried through the reaction system, the shield gas is capable of shielding the first sample when the first sample is contacted with the aqueous hydrofluoric acid solution, thereby producing the liquid reaction mixture and at least one exhaust gas;

an abatement line; and

an abatement unit comprising an abatement vessel and an aqueous caustic solution,

wherein the abatement line is capable of carrying the exhaust gas from the impinger to the abatement unit, and

(ii) said sampling unit being capable of:

~~(i)~~ collecting a first sample from the halosilane supply line, wherein the first sample comprises the halosilane; and

~~(ii)~~ contacting the first sample with an aqueous hydrofluoric acid solution, thereby producing a liquid reaction mixture,

wherein at least one chemical reaction occurs as a result of the contacting step, wherein the chemical reaction comprises the halosilane reacting with the aqueous hydrofluoric acid.

Claim 54 (previously presented): The system of claim 53, wherein each w, x, and y is 0.

Claim 55 (cancelled)

Claim 56 (currently amended): A system, comprising:

(a) a processing tool to process workpieces,

(b) a halosilane supply line coupled to said processing tool, said halosilane supply line to supply at least one of trichlorosilane, dichlorosilane, tetrachlorosilane, and tetrafluorosilane for said processing of ~~semiconductor wafers~~ workpieces, ~~wherein the chlorosilane~~,

(c) a sampling unit coupled to the tool and halosilane supply line, wherein

(i) said sampling unit comprises:

a sample introduction line to carry the first sample;

a shield gas supply line;

a shield gas functional line,

wherein the shield gas supply line and the shield gas functional line are to carry a shield gas,

wherein the shield gas functional line has a longitudinal axis that is parallel to the longitudinal axis of the

sample introduction line, and the sample shield gas functional line jackets at least a portion of the sample introduction line,

wherein the jacketed portion of the sample introduction line comprises an open end and a continuing end, and

wherein the shield gas functional line comprises a first end that is sealed to the continuing end of the portion of the sample introduction line and an open end;

a connector that connects the shield gas supply line and the shield gas functional line,

wherein the open end of the jacketed portion of the sample introduction line and the open end of the shield gas functional end are on the same side relative to the connector; and

an impinger comprising a reaction vessel and the aqueous hydrofluoric acid solution therein,

wherein the open end of the shield gas functional line and the open end of the jacketed portion of the sample introduction line are positioned below the surface of the aqueous hydrofluoric acid solution, and

wherein the open end of the shield gas functional line and the open end of the sample introduction line are positioned relative to one another such that when the shield gas and the first sample are carried through the reaction system, the shield gas is capable of shielding the first sample when the first sample is contacted with the aqueous hydrofluoric

acid solution, thereby producing the liquid reaction mixture, and

(ii) said sampling unit being capable of:

~~(i)~~ collecting a first sample from the halosilane supply line, wherein the first sample comprises at least one of trichlorosilane, dichlorosilane, tetrachlorosilane, and tetrafluorosilane; and

~~(ii)~~ contacting the first sample with an aqueous hydrofluoric acid solution, thereby producing a liquid reaction mixture,

wherein at least one chemical reaction occurs as a result of the contacting step, wherein the chemical reaction comprises the halosilane reacting with the aqueous hydrofluoric acid.

Claim 57 (previously presented): The system of claim 56, wherein the first sample comprises trichlorosilane.

Claim 58 (currently amended): The system of claim 56, further comprising a process controller coupled to the processing tool, the halosilane supply line, and the sampling unit, said process controller ~~unit~~ to control an operation of at least one of the processing tool, the halosilane supply line, and the sampling unit.

Claim 59 (cancelled)

Claim 60 (currently amended): The system of claim [[56]] 56, wherein the workpieces are semiconductor wafers.